

# The Fundamental Movement in Sports

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In tennis, the players at the net, like the [in-fielders](#) in baseball/softball have to be quick off the ball because they are close to the persons striking the ball and neither have much time. Players at the baseline, like outfielders in [baseball/softball](#) have to be quick off the ball so as to move laterally, up or back to cover the greater distances involved from those positions. It makes one wonder if the preparation and timing of these initial movements should be different for either position in either sport? And, to get the maximum advantage would it be smart to start all movements at the earliest possible moment after the player determines the direction of the ball?

In all sports there is a 'special time' during a 'sport specific action' that is rather unique and distinct from all the others. For example, consider the time of impact 1) one has just seen the path the player took in getting to the hitting position 2) one has just watched the motion of the player's racket leading up to impact 3) one can see the opponent's body position at impact 4) one is going to hear the loudness of the impact 5) and the ball is about to change direction. This available information will be used to anticipate where a defensive player positions themselves for the next offensive shot. How much of this information is used in picking the correct location will depend on the skill level of the player about to respond to the ball. For instance, Nadal may process all the information while Karlovic may use less or prioritize the information differently.

Anticipation skills (i.e. deciding where your opponent is going to hit) must be developed thru playing experience, but should not interfere with properly timing the split-step. Both can be used to maximize one's abilities of getting to the best possible hitting position in the shortest amount of time.

Timing the split-step properly allows the player to be moving at maximum speed (or ready to start moving) at exactly the time they determine the direction of the incoming ball, independently of where they are on court. A player that waits until the ball has traveled a considerable distance, to be sure of the direction, may compromise his or her ability to get to the proper hitting position for the more difficult shots. Other refinements or adjustments for ball speed, spin, depth, and contact point, can be made as the motion towards the ball proceeds, but determining the direction as soon as possible is top priority.

[Misunderstanding](#) the split step appears on TV and at coaching seminars all the time, so one should take the time to understand what it is that professional players are doing on the field or court.

[Nick Saviano](#) in his book 'Maximum Tennis' says, "You should take a split-step every time your opponent contacts the ball. A proper split-step is arguably the most important aspect of footwork. Performing the split-step at the correct time will establish your balance so that you are in a position to explode to the ball once you recognize the direction of the shot. In addition, it heightens your mental state of awareness at a critical time when the ball is coming off your opponent's racquet."

## **Forces and Movement**

The 2005 NORCAL USPTA Conference had a seminar called, "A Fundamental Sequence to Movement," that showed in great detail very special times during a movement. These key frames include: 1) when the last foot comes off the ground, 2) when the player determines the ball direction, and 3) which foot lands on the court first. These movements have been documented by [John Yandell](#) for Guga, Hewitt, Safin, Roddick, and Haas as they make their initial moves; the YouTube video of [Tommy Haus](#) illustrates these key times.

Other [videos](#) show that tennis professionals are in the air whenever a ball is struck by an opponent; not all players are able to execute 'perfect timing' under the stress of playing a point. The video clip of [Karlovic serving and Nadal returning](#) at the 2010 Aussie Open is a good example of this fact.

The slow motion video clip freezes the serve and all other shots at ball contact time and then shows the receiver's vertical position relative to the Top of the Hop. Notice that Nadal was always at the Top of the Hop when Karlovic struck the ball! On the other hand notice that Karlovic missed 4 of the 9 split-steps and in particular the last hit by Nadal as Karlovic came to net and made a late hop into the air. Being late meant that he was left 'hanging' in the air waiting to come down to the ground so he could begin accelerating in the direction of the ball.

When a player hops into the air and lands on the ground, an impulse force is generated (an impulse force is a force that results when one moving object hits or collides with another object that is either moving or stationary). This impulse force is short and lasts for about 1/2 sec (500 mSec or 16 video frames), and its magnitude is always greater than the static force by a factor of about 3 (a static force is similar to a person standing on a bathroom scale, where-in the magnitude of the force is equal to the weight of the individual).

A [player](#) landing on 1 foot can take advantage of this larger impulse force, but if they land on both feet the impulse force is felt by both feet and cancels any sideward force that could help accelerate the player in a particular direction. The player that lands on both feet will be starting their movement from a compromised position, where-in the foot closest to the ball is lifted off the ground capitalizing only on the static force *and* a loss of time; we call this movement a Jab Step. This movement will always be slower than landing on the foot opposite to the side the ball is coming to. Consider the [2012 World Series](#) clips of Cabrera and Sandoval (3<sup>rd</sup> basemen for the Tigers and Giants) and

compare how landing on two feet is over twice as slow, in starting, as landing on 1 foot.

[Jack Groppe](#) in his book High Tech Tennis said something I think all of us can agree on, "The factor in tennis that most limits players' success is movement. In fact, I feel that it really doesn't matter how great your strokes are if you are not in the right place at the right time." He also mentions that the average distance you run for a ball will be between 2 to 6 yards and this is one of the main reasons we at [Sports-Split-Step](#) have put so much time into understanding what happens before your opponent kicks, hits or throws an object. The following section will break down the movements and discuss what should be happening in preparing for the split-step.

## Timing the Movement

The split-step can be discussed by considering these three movements:

1. Preparing to hop - We need to load our legs by bending our knees before the opponent strikes the ball. Visualize bouncing on a [Pogo Stick](#).
2. Hopping - The hop into the air must be timed so that we reach our maximum height just as the ball starts to come off the opponent's racquet.
3. Landing - As we begin to descend we will determine the direction of the ball, prepare our body to run by starting to turn the feet. For example, lift the leading leg, and load the trailing leg that is going to drive us towards the ball. Studies<sup>1</sup> have shown that the

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<sup>1</sup> [Journal of Sports Sciences](#) October 2009; 27(12): 1233-1240 RYOTA UZU, MASAHIRO SHINYA, & SHINGO ODA Graduate School of Human and Environmental Studies, Kyoto University, Kyoto, Japan (Accepted 4 August 2009)

gastrocnemius medialis and soleus muscles (our calf leg muscles) are firing even before the off-side foot hits the ground. The Stretch-Shortening Cycle (SSC) comes into play and increases the driving force by adding to the impulse force generated by the landing.

High hops result in a large impulse force (an advantage), but use more energy and can result in lost time. For example, if you mistimed the hop and are still in the air, you cannot start the acceleration towards the target until your foot hits the ground. A high hop is generally found with players that have played mostly on hard courts whereas a lower hop is generally found with players that play on clay. The reason is that the lateral force can be so large for higher hops that the clay will cause the player's foot to slip as he begins the lateral movement. Guga has a lower hop where Hewitt has a much higher hop.

Towards the completion of the hop, a player should be landing with the loaded leg (i.e. in the pre-stretch part of the stretch-shortening cycle) exerting the maximum effort as the foot nears the ground (the other foot would not be touching the ground at this time). The leg movement is described as a 'stretch-shortening cycle'<sup>2</sup> and can have a profound effect on the power generated by the foot/leg. If the off side foot touches the ground just after the leg begins to unload, the player will maximize the force applied to the ground. This description of the timing should be the goal for all coaches and players wanting to learn to move more quickly!

Compare the side by side videos of [Marat Safin](#) as he executes a properly timed split step with a split step that is early (thus forcing him to land on both feet). Notice how his left foot/leg lands at exactly

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<sup>2</sup> [Developing Agility and Quickness](#) Copyright 2012 by National Strength and Conditioning Association pages 53, 72, 75, 77, 84

the same time for both shots, but the properly executed split step will propel him more quickly towards the ball. This can be observed by comparing where the left foot/leg is at in both frames; the distance is nearly 1 full stride ahead with the properly executed split step.

So, what happens when the ball is hit within 5 feet of the defensive player? Most professional players will tend to land on both feet as the distance they need to travel can easily be reached and does not require the impulse force, but the timing for the hop remains exactly the same; begin the hop before the opponent makes ball contact so as to be at the 'top of the hop' when the ball is contacted.

If you look closely at a return of serve to the body, you will sometimes notice that a one foot landing still occurs. In other words, any time we want to move quickly on the first step, whether it is moving to a ball or out of the way of a ball, we move faster if we can utilize the one foot landing and capitalize on the resulting impulse force.

Landing on one foot when an overhead or drop-shot are hit against us can result with the same impulse force and the resulting benefits. For example, 1) prepare to hop as usual 2) determine the direction of the ball while in the air (short in the court or up over one's head), 3) begin to rotate the feet/shoulders so that they are approximately 90 degrees to the net (square position), and 4) land on the foot closer to the net (left foot for 'righties') for the lob over your head or the back foot if the opponent's shot was a short lob or a drop-shot.

Landing on one foot for a volley can result in similar benefits. For instance: 1) start the hop before the ball is struck by the opponent, 2) determine the direction while in the air, 3) load by beginning to rotate the feet/shoulders in a direction for either the backhand or forehand volley, 4) land on the rear foot so that the resulting impulse force propels us towards the net or in the direction required to intercept the volley.

[Ivan Lendl](#) was quoted in July 2010 Tennis magazine as saying, "When you don't move well, you don't get to the shot, and if you don't get to the shot, I don't care how good you are, you can't hit it properly."

## Teaching the Movement

By applying the following steps to your game, they will ultimately make you a more aggressive player and you will start creating shots and strategies instead of just reacting to your opponent's shots. Here are some guidelines that might help convince and thus motivate your players and peer group to take the time and learn to move like professional players. Learning to visualize the flow of a pattern of play is essential to developing the sensor-motor pathways and this takes many repetitions. Professional athletes often use mental visualization of 'movement patterns' prior to competition.

1. Show the high speed movements using the slow motion videos used in this document.
  - [Tommy Haus](#) split-step
  - [Karlovic and Nadal](#)
  - [Marat](#) Side by Side Jab Step vs split-step
2. Eliminate the [misconceptions](#) and use video to show what is happening and then define these essential steps for yourself.
  - Preparing to hop
  - Hopping
  - Landing
3. Devise drills that can work with each of the essential steps.
4. Practice with many repetitions and error on the side of 'perfect' execution before moving on to more difficult concepts.

5. Provide drills with progressive stages of difficulty which will continue to challenge, always forcing players to border on the edge of failing *some* of the time.

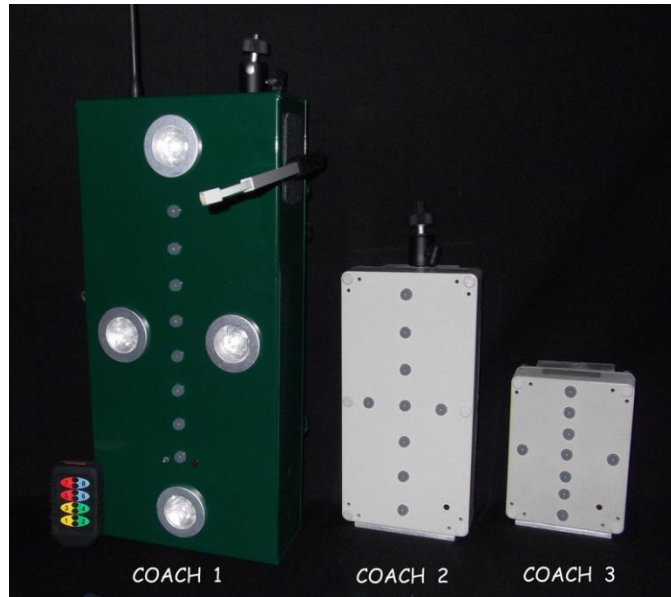


6. Do not use balls when first working with players so that they can concentrate on footwork and really perfect the movements. [Tim Mayotte](#) was a top competitor because of his footwork skills and has recently given a seminar at Stanford (USPTA Feb 2012) emphasizing the importance of something he calls [shadowing](#).
7. Then interleave balls into the workout by tossing balls by hand, but continue your drills without balls.
8. When stroke and movement levels have improved challenge the players with using ball machine with Timing Lights so that the split step can be timed properly with their movement.
9. Teaching the split-step to younger players enables them to acquire this skill early on and eliminate or 'unlearn' nasty habits.

There are several [simpler techniques](#) that have been used prior to today's modern electronic tools. Here are some teaching tools & training devices that can help a player improve their split step:

1. [Footwork training devices](#) can provide visual and auditory cues for learning the split step movements without having to use balls. This device works well when performing '[shadowing](#)', with the timing determined by the training device. The players are driven to execute based on information obtained thru eyes and ears for both the 'hop' and the 'swing' at the imaginary object (i.e. tennis ball, soccer ball, etc).





2. [A Timing Device & video camera](#) used with the Split Step Coach allows measurements of athlete's performance. The Split Step Coach can be operated at the baseline, net, [tripod](#) or from your ball cart.



3. [Bungee apparatus](#) can enable sport [specific muscle groups](#) to be strengthened while timing your movements.



Power builder



Power Resist

4. [Rope Ladders](#), Quick Release Sprinter and other available tools for developing movement



5. Students can use a simulated [footwork training device](#) while standing in front of their computer screen using this video.
6. [Ball machines with Timing Lights](#) allow introduction to the cues that can be used for [teaching a proper split step](#).



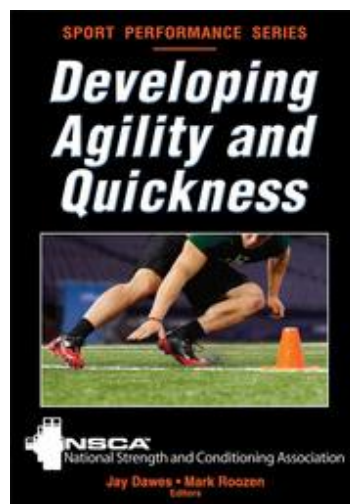
7. Dynamic weight training for [strengthening](#) sport specific muscles groups.
8. Sprints and other running drills for aerobic and anaerobic training

## Summary

At this point we begin to realize initial starting movements can be executed with the same split step timing and movement! Using modern teaching tools the teaching professional, for just about any sport, can tailor practice sessions with their athletes and utilize the impulse force in conjunction with the split step and make this entire movement a conditioned response. In addition the Split Step Coach series of products provides the timing for deceleration to the execution point at which the sport specific shot, kick, jump or throw occurs.

Daniel Coyle in his book, "[The Talent Code](#)" says, "Repetition is invaluable and irreplaceable. Spending more time is effective, but only if you're still in the sweet spot at the edge of your capabilities, attentively building and honing the neural circuits".

Here is another excellent book on agility training whose drills integrates with the Sports Split Step timing devices we have shown in this article:



Vic designs, builds and tests training devices for teaching cutting edge concepts in the sports of tennis, badminton, volleyball, hockey, soccer, and baseball. He has taught for over 18 years as a USPTA tennis teaching professional with 35 years of background in electronic hardware and software product development. Products can be seen at [Sports-Split-Step.com](http://Sports-Split-Step.com) and Vic can be reached at [vicborg70@gmail.com](mailto:vicborg70@gmail.com)

